

## Reproductive System

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## Sexual Development

- In the seventh week of development the testes in males and the ovaries in females develop.
  - testes produce testosterone
  - ovaries produce estrogen
- At puberty the testes and ovaries start producing active reproductive cells
  - Puberty usually begins between the ages of 9 and 15 when the hypothalamus signals the pituitary to produce increase levels of follicle-stimulating hormone (FSH) and luteinizing hormone (LH)

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## Male Reproductive System

- FSH and LH stimulate the production of testosterone
- FSH and testosterone cause the development of sperm

### The Testes

- develop within the abdominal cavity and drop into the scrotum normally just before birth
- remain in the scrotum where the temperature is normally a few degrees lower than normal body temperature ( $37^{\circ}\text{C}$ )
  - lower temp needed for proper sperm production
- within each testis are hundreds of tiny seminiferous tubules that are responsible for producing sperm

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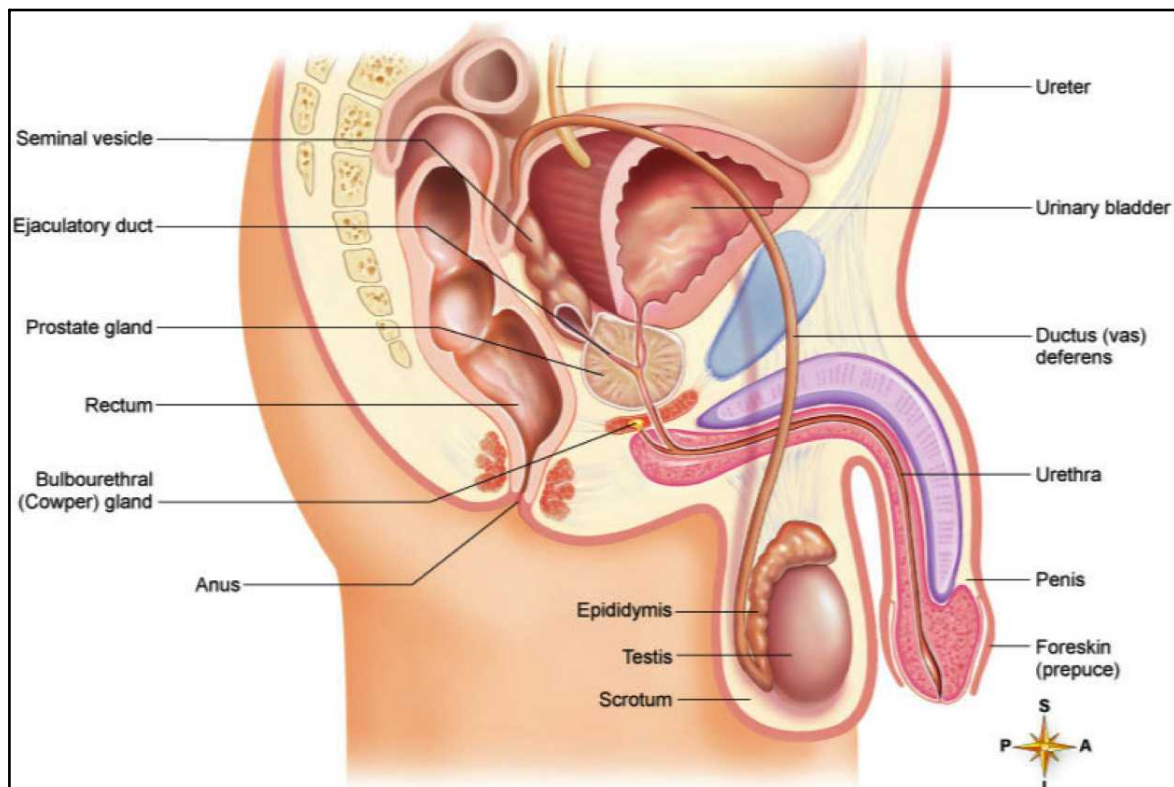


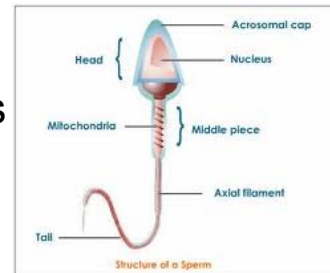
Fig. 22-1. **Organization of the male reproductive organs.** Sagittal section of pelvis showing placement of male reproductive organs.

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## Sperm Development

- created through the process of meiosis (haploid cell)
- sperm have three parts:
  - head - has highly condensed nucleus
  - midpiece - packed with mitochondria
  - tail - flagellum (propels the cell)
- sperm produced in the seminiferous tubules are moved into the epididymis to fully develop.
- vas deferens extends from the epididymis into the abdominal cavity and eventually merges with the urethra
- urethra leads outside the body through the penis



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- The glands lining the reproductive tract include the:
  - Seminal Vesicle
  - Prostate
  - Bulbourethral
- Glands are responsible for producing seminal fluid. The fluid has two roles:
  - 1) nourishes the sperm
  - 2) protects the sperm from the acidity of the female reproductive tract

sperm + seminal fluid = semen

1 ml of semen = 2.5 billion sperm

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### Sperm Release

- when a male is sexually aroused the autonomic nervous system prepares the penis for sperm delivery by causing the contraction of smooth muscles
- ejaculation is not completely voluntary
- the average male releases 2-6 ml of semen each ejaculation

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## The Female Reproductive System

- puberty starts when the hypothalamus instructs the pituitary gland to release FSH and LH.
- FSH stimulates the ovaries to produce estrogen
- main job of the female reproductive system is to produce ova and to prepare the female's body to nourish the developing embryo
- female reproductive system usually only produces one mature ovum (plural ova) each month

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## Egg Development

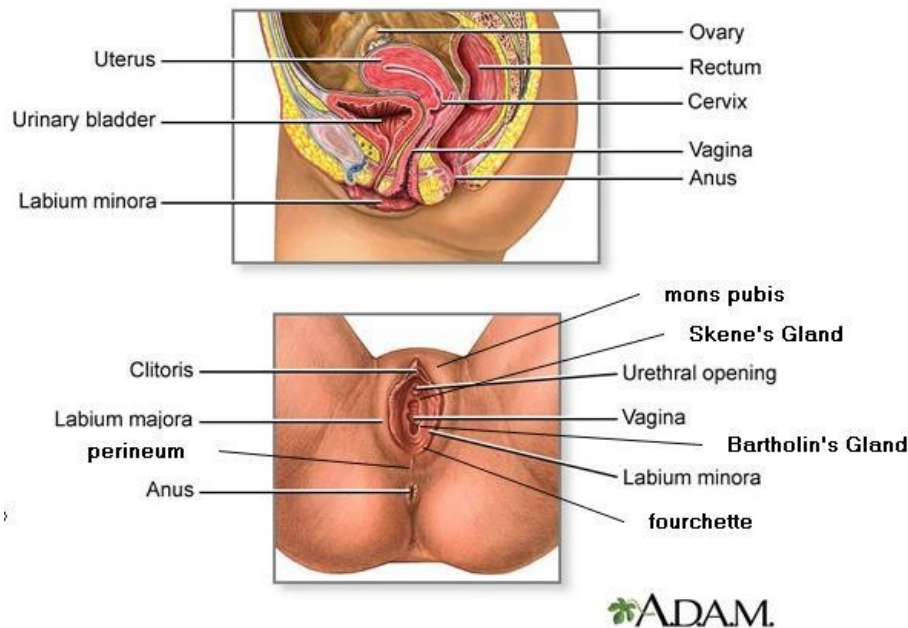
- each ovary contains about 400 000 primary follicles
  - follicles are clusters of cells surrounding a single egg
- females are born with thousands of immature eggs (primary follicles), only about 400 eggs will actually be released.
- under the influence of FSH a follicle will get larger and completes the meiotic cell division (creates 3 polar bodies and 1 large egg cell)

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## Egg Release

- when a follicle has completely matured the egg is released in a process called ovulation
- the follicle will break open and the egg is swept from the surface of the ovary into the Fallopian tube
- eggs move through the fallopian tubes with the help of cilia
- eggs are fertilized as they travel through the fallopian tubes
- after a few days the egg exits the fallopian tube into the uterus (if the egg is fertilized it attaches to the uterine wall)

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## The Menstrual Cycle

- occurs on average every 28 days
- regulated by the hormones made in the hypothalamus, pituitary gland, and ovaries
- begins in puberty and continues until estrogen production declines and this usually begins when a female is in her mid to late 40's
- permanent stopping of the menstrual cycle is called menopause (average age = 51)
- has four phases
  - follicular phase
  - ovulation
  - luteal phase
  - menstration

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### Follicular Phase (~10 days)

- begins when the level of estrogen in the blood is low causing the hypothalamus to stimulate the anterior pituitary to release FSH and LH
- FSH and LH travel through the circulatory system to the ovaries and stimulate the development of a follicle
- as the follicle develops it stimulates the production and release of estrogen.
- increase in estrogen levels cause the lining of the uterus to thicken in preparation to receive a fertilized egg

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### Ovulation (~3-4 days)

- hypothalamus stimulates the pituitary to release even more FSH and LH
- increase levels of FSH and LH cause the follicle to rupture and release a mature egg into the fallopian tube

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**Luteal Phase (~ 7 - 12 days)**

- begins when the egg is in the fallopian tube
- follicle turns yellow and is now known as the corpus luteum
- corpus luteum releases both estrogen and progesterone to simulate cell growth and tissue development in the lining of the uterus
- 10 - 14 days after the end of the last menstrual cycle is the greatest chance for the egg to become fertilized
- progesterone also causes the blood supply in the uterus to increase
- If the egg is fertilized it will begin to undergo cell division
- after several divisions the ball of cells will implant itself in the lining of the uterus

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**Menstruation (~ 3 - 7 days)**

- occurs if fertilization does not occur
- unfertilized egg will pass through the uterus 2 - 3 days after ovulation and corpus luteum will begin to disintegrate
- as the corpus luteum disintegrates it releases less estrogen and progesterone causing the lining of the uterus to detach from the uterine wall
- a few days after menstruation ends the estrogen levels in the blood are again low enough to stimulate the hypothalamus to begin the process all over again.

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## Sexually Transmitted Infections

- infect millions of people a year and kills thousands (in Canada and the US alone)
- safest course to avoid STIs is to abstain from sexual contact however the next safest course is to use a latex condom. No method other than abstinence is 100% effective

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### **Bacteria Caused STIs:** - treatable with antibiotics

#### 1) Chlamydia

- one of the fastest spreading STI.
- caused by a bacteria infection that is transmitted by sexual contact
- causes damage to the reproductive system and that can lead to infertility

#### 2) Syphilis

- fatal

#### 3) Gonorrhea

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## **Viral STIs**

- 1) Hepatitis B
- 2) Genital herpes
- 3) Genital warts
- 4) AIDS - result of human immunodeficiency virus (HIV)

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## **Fertilization and Development**

### **Fertilization:**

- sperm is released when semen is ejaculated through the penis into the vagina.
- penis usually penetrates into the vagina to the point just below the cervix (opening connecting the vagina to the uterus)
- sperm actively swims through the uterus to the fallopian tubes in hopes of uniting with an egg
- egg is surrounded by a protective layer that contains binding sites for sperm

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- once a sperm attaches to a binding site it will release enzymes that will help it breakdown the protective layer surrounding the cell
- sperm nucleus then enters the egg and the chromosomes from the sperm and egg are brought together (FERTILIZATION)
- the two haploid nuclei fuse to create a single diploid nucleus to create a fertilized egg (a zygote)

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### Early Development

- four days after fertilization the embryo is a ball consisting of approximately 64 cells is now called a morula
- consists of three separate stages

#### 1) Implantation

- morula grows and develops into a hollow structure with an inner cavity called a blastocyte
- 6 or 7 days after fertilization the blastocyte implants itself into the wall of the uterus
- blastocyte begins to differentiate into various types of tissue and a cluster of cells in the inner cavity will differentiate into the tissues surrounding the embryo

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## 2) Gastrulation

- inner layer of the blastocyst sorts itself into two then three layers the primary germ layers
  - ectoderm - becomes skin and nervous system
  - mesoderm - internal tissues and organs
  - endoderm - lining of the digestive system

## 3) Neurulation

- development of the nervous system
- part of the mesoderm begins to differentiate into the notocord - spinal cord and brain will develop from this.

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## Extraembryonic Membranes

- amnion and the chorion develop to protect and nourish the embryo
  - amnion develops into the amniotic sac - cushions and protects the embryo
  - chorion develops into the placenta

## Placenta

- embryo's organ of respiration, nourishment, and excretion
- connection between the embryo and the mother to supply the embryo with nutrients via diffusion
- blood of the mother and the child should not mix they are separated by the placenta

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- 8 weeks
  - the embryo is called a fetus.
- After 3 month
  - the fetus should have most of its major organs and tissues and the umbilical cord is formed
    - Umbilical cord - has two arteries and one vein which connects the fetus to the placenta
  - fetus is about 8 cm long and has a mass of 28 grams

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## Later Development

### 1) Months 4 - 6

- the tissues of the fetus become more complex
- fetal heart becomes large enough to begin to function
- bone begins to replace cartilage to form the skeletal system
- fetus develops hair
- mother's abdomen swells to accommodate the fetus

### 2) Months 6 - 9

- organ systems mature - prep for life outside the womb
- fetus doubles in mass and increases in size
- fetus is able to regulate its temperature
- Babies born before 8 months are generally called premature and often have severe breathing problems because of incomplete lung development

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**Childbirth**

- release of oxytocin affects a group the involuntary muscles in the uterine wall to begin rhythmic contractions (labor)
- cervix opening expands
- at some point the amniotic sac breaks and the fluid it contains rushes out of the vagina
- contractions of the uterus generally forces the baby (usually head first) out through the vagina
- the baby will cough or cry upon entering the outside world to expel fluid from his or her lungs

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- blood supply from the placenta begins to dry up - cord is cut and clamped (dries up and leaves a scar called the naval)
- series of contractions will expel the placenta and the empty amniotic sac
- a few hours after birth the pituitary releases prolactin to stimulate the production of milk

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## Multiple Births

- Fraternal Twins
  - occur when two different egg and sperm cells unite
- Identical Twins
  - formed when the zygote splits apart to produce two embryos

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## Early Years

- 1) Infancy (first 2 years of life)
  - period of rapid growth and development
  - nervous system develops coordinated movement
  - teeth develop
  - child begins to understand and use language
- 2) Childhood (2 -12)
  - child becomes more active and independent
  - personality and social skills are developed along with reasoning skills
  - 80% of skeletal size is achieved
- 3) Adolescence (13 - adulthood)
  - puberty begins
  - ossification of bones occurs
  - intellectual skills continue to develop

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## Adulthood

- highest levels of physical strength and development occurs between age 25 and 35
- first signs of aging occur in the 30's
  - loss of flexibility
  - body systems become less effective
- age 50 menopause occurs
- age 65 homeostasis becomes difficult to maintain due to a decrease in the efficiency of the body systems

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